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Trends in sizes of breeding duck populations in western Canada, 1955–89

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Introduction

Changes in the sizes of duck populations have been monitored annually since 1955 over nearly 3.6 million square kilometres of breeding habitat in Montana and North and South Dakota in the United States, the western Canadian Prairie provinces, the Mackenzie Valley of the Northwest Territories, and parts of Alaska (Fig. 1). These surveys are conducted cooperatively by the Canadian Wildlife Service (Western and Northern Region) and the U.S. Fish and Wildlife Service.

The results of these surveys provide information on abundance and distribution of duck populations, as well as changes in habitat, and form a basis for management of most duck species. Species showing long-term progressive declines in continental numbers require special consideration when goals for habitat acquisition and/or securement are being set during management of breeding, staging, or wintering areas. Species maintaining stable populations over the long term, but with significant declines in recent periods, similarly deserve attention.

It can be difficult to identify underlying trends in population indices. Plots of indices over the period between 1955 and 1989 show large annual fluctuations in response to the periodicity of the drought cycle. The timing of the survey in relation to chronology of the breeding season and such factors as weather and time of day also account for some fluctuations, although techniques have been standardized to minimize the effect of differences in survey operations. The large annual variations tend to obscure the underlying trends.

The purpose of this analysis is to present an objective technique for identification of temporal trends in population indices despite the large annual variations. I used route-regression analysis (Geissler and Noon 1981) to describe patterns in duck population indices for the western survey area.

Methods

The waterfowl population survey method has been well described (U.S. Fish and Wildlife Service 1987). The route-regression technique developed by Geissler and Noon (1981) and modified by Collins and Wendt (1989) was used to determine the percent change in population size over three time periods. A brief description of the analytical procedure follows.

The population index for each stratum was transformed to the logarithmic scale, as a multiplicative model has generally been found to be suitable for population data (Collins and Wendt 1989). Simple parametric regression was calculated for each species in each stratum to provide an estimate of trend over time. Results for each stratum were then grouped with results for other strata of similar macrohabitat characteristics to give an overall estimate of trend for each of five regions. The regions were as follows (for location of each stratum, see Figure 1):

(1) *U.S. prairies:* strata 41–49
(2) *Canada prairie/parkland:* strata 26 – 40
(3) *Boreal:* strata 12–25, 50
(4) *Alaska:* strata 1–11
(5) *Continental*: strata 1–50.

Weighting factors were used to account for differences in precision of the trend in each stratum (strata where the trend was more precise were given greater weight) and for differences in the average population size of the stratum (strata with larger populations were assigned greater weight). Statistical significance of the slope of the trend was determined using a permutation test (Collins and Wendt 1989).

The analysis to calculate the percent change in population index was repeated over three time periods of interest:

(1) the long term (1955–89);
(2) the last 10 years (1980–89); and
(3) the most recent 5 years (1985–89).

Given the large annual fluctuations that occur, it was unlikely that a dataset spanning only 5 years would show a statistically significant trend. The analysis was completed despite this limitation, because the direction of the change was informative even if it was not significant. A significant trend implied that the change over that short time period was direct and precise with little variability.

Results

Table 1 shows the trend in population size for the five regions. The trend is expressed as the percent change in the size of the population over the entire time period of each analysis.

The most outstanding result is that five of seven species of dabbling ducks have declined significantly over the long term (1955–89) in the Canadian prairie/parkland: Mallard *Anas platyrhynchos*, American Wigeon *A. americana*, Blue-winged Teal *A. discors*, Northern Shoveler *A. clypeata*, and Northern Pintail *A. acuta*. Of these five dabblers, the continental populations of Mallard, Blue-winged Teal, and Northern Pintail have also declined significantly. In contrast, all seven species of dabbling ducks showed a significant increase in Alaska, and all but one (Northern Pintail) showed stable or increasing populations in boreal regions and the U.S. prairies. Populations of Green-winged Teal *A. crecca* and Gadwall *A. strepera* showed large continental increases over time.

The trends observed over the most recent 10 years (1980–89) and the most recent 5 years (1985–89) were more or less the same: stable or increasing populations in the northern zones, with declining trends in the more traditional breeding areas.

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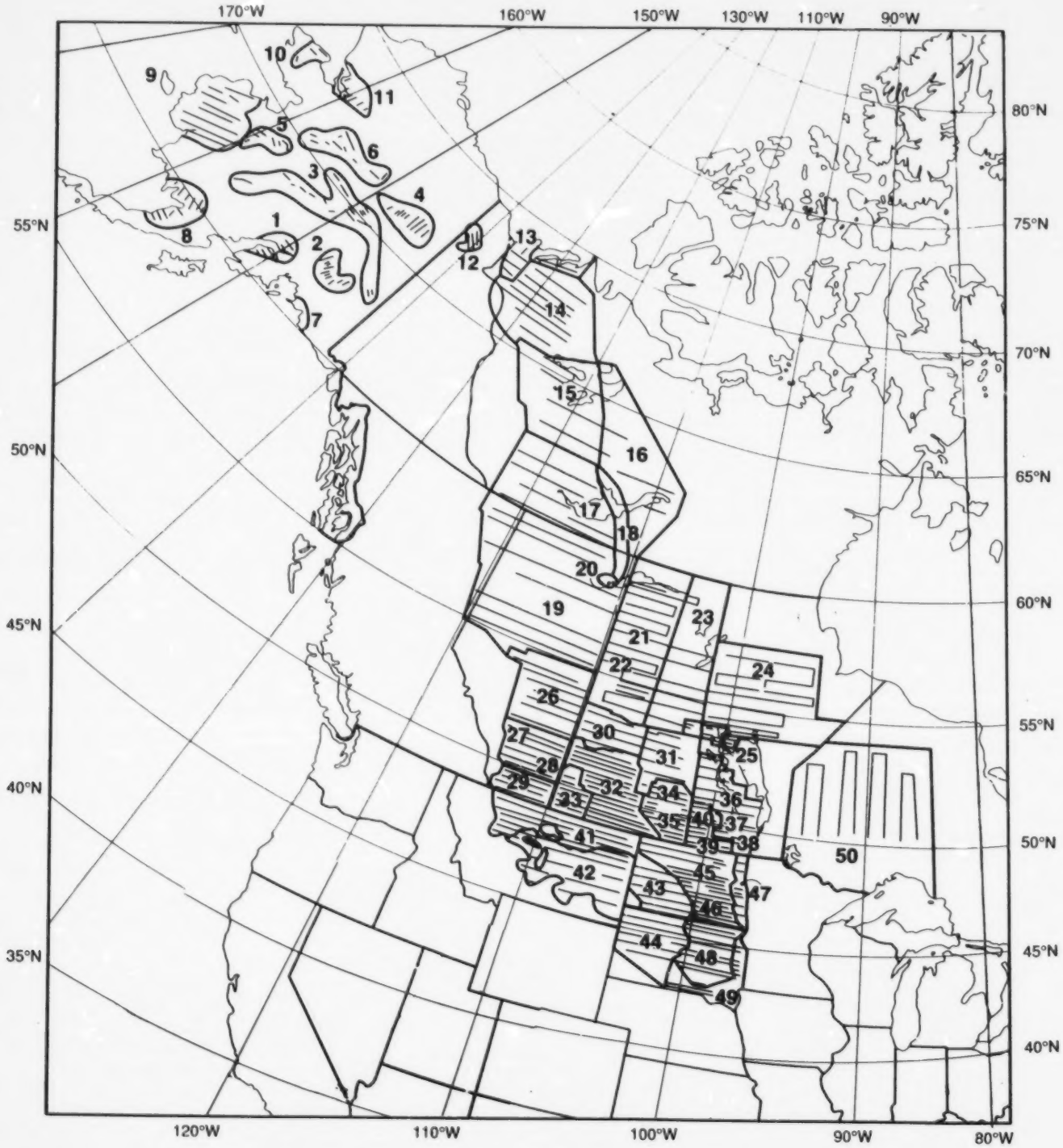
Figure 1
Transects and strata for annual western waterfowl breeding populations and habitat surveys



Despite the small sample size for the 5-year analysis, declining trends for Mallards, Gadwall, Blue-winged Teal, Northern Shovelers, and Northern Pintails were significant.

All species of diving ducks, and the Ruddy Duck *Oxyura jamaicensis*, showed increasing or stable continental populations (Table 1) over the long term (1955–89). However, results for Canvasbacks *Aythya valisineria* and scaup showed significantly declining trends since 1980 in most macrohabitat types.

Plots illustrating population indices over time for selected species are provided for comparison in Appendix A.

Discussion

Geissler and Noon (1981) developed the route-regression technique for analysis of trends in the Breeding Bird Survey (BBS). BBS data are population indices based on call counts of avian species along transects run annually. Geissler and Noon (1981) found the route-regression method gave the smallest confidence intervals and was more sensitive to changes in population index than the other techniques tested.

Survey data for the May waterfowl breeding population and habitat surveys are similar to BBS data in many ways: they are indices (not absolute estimates), they are collected annually along fixed transects, and they fluctuate widely from year to year. The route-regression technique was designed to accommodate these characteristics and hence is appropriate for analysis of the May waterfowl survey data.

It is important to detect trends in population indices, so that undue significance is not attached to values achieved in any single year. In this study, route-regression analysis identified significant long-term declines in the sizes of the continental populations of some species. Mallards, Blue-winged Teal, Northern Pintail, Canvasback, and scaup showed significant population declines.

The declining trends for the overall populations are a reflection of the importance of the southern breeding areas to the continental populations, as the continental declines have arisen primarily from loss of breeding habitat in the southern Prairie provinces. The declines correlate in part to decreases in pond availability (Table 1). Johnson and Shaffer (1987) showed that the relationship between numbers of Mallards and numbers of ponds was good in the period 1955–70 but less obvious in 1971–85; they concluded that the relationship between Mallards and numbers of ponds is not as strong as it was. They also used a regression model to relate Mallard numbers in a given year to pond numbers in each of the previous 2 years and concluded that numbers of Mallards in recent years were fewer than would be expected based on the number of ponds. Thus, factors other than availability of breeding habitat have also influenced population size.

The trend analysis also showed that duck populations in Alaska have been increasing, including populations of those species generally considered to be prairie nesters. This change in distribution has occurred in conjunction with loss of breeding habitat in more traditional breeding areas farther south. The same pattern has been observed to some extent in boreal breeding areas. The increases in northern populations have not, however, balanced declines observed elsewhere, presumably because productivity is lower at northern latitudes.

Table 1
Percent change in size of populations of duck species on the surveyed area over the long term (1955–89), over the past 10 years (1980–89), and over the most recent 5 years (1985–89)

Species/Area	1955–89	1980–89	1985–89
Mallard			
U.S. prairies	– 13 ns	32 *	28 *
Canada prairie/parkland	– 46 **	– 49 **	– 36 **
Boreal	– 5 ns	– 5 ns	66 *
Alaska	128 **	2 ns	133 **
Continental	– 28 **	– 22 **	10 ns
Gadwall			
U.S. prairies	53 *	46 *	44 *
Canada prairie/parkland	22 *	– 18 ns	– 33 *
Boreal	498 **	9 ns	158 *
Continental	40 **	5 ns	1 ns
American Wigeon			
U.S. prairies	117 **	– 55 **	– 47 ns
Canada prairie/parkland	– 45 **	– 11 ns	– 1 ns
Boreal	– 1 ns	– 27 *	46 ns
Alaska	398 **	– 31 **	45 **
Continental	8 ns	– 30 **	15 ns
Green-winged Teal			
U.S. prairies	92 **	– 44 *	– 25 ns
Canada prairie/parkland	43 **	23 ns	47 ns
Boreal	79 **	33 ns	71 *
Alaska	389 **	31 ns	57 **
Continental	88 **	24 ns	57 **
Blue-winged Teal			
U.S. prairies	– 18 ns	36 ns	– 31 ns
Canada prairie/parkland	– 35 **	– 50 **	– 47 **
Boreal	139 **	– 3 ns	175 *
Continental	– 19 **	– 19 ns	– 21 ns
Northern Shoveler			
U.S. prairies	79 **	46 ns	14 ns
Canada prairie/parkland	– 18 *	– 34 *	– 60 **
Boreal	18 ns	52 ns	105 **
Alaska	2293 **	– 9 ns	107 **
Continental	24 **	– 2 ns	– 11 ns
Northern Pintail			
U.S. prairies	– 48 **	– 33 ns	– 53 *
Canada prairie/parkland	– 66 **	– 77 **	– 63 **
Boreal	– 47 **	– 32 ns	– 15 ns
Alaska	47 **	– 40 **	50 *
Continental	– 42 **	– 53 **	– 21 ns
Ruddy Duck			
U.S. prairies	523 **	26 ns	– 13 ns
Canada prairie/parkland	23 ns	– 20 ns	– 14 ns
Boreal	115 ns	– 15 ns	53 ns
Continental	122 **	– 1 ns	– 8 ns
Redhead			
U.S. prairies	161 **	20 ns	3 ns
Canada prairie/parkland	38 **	– 20 ns	– 30 ns
Boreal	– 45 *	– 68 *	37 ns
Continental	50 **	– 14 ns	– 14 ns

(continued)

Table 1 (Cont'd)
Percent change in size of populations of duck species on the surveyed area over the long term (1955–89), over the past 10 years (1980–89), and over the most recent 5 years (1985–89)

Species/Area	1955–89	1980–89	1985–89
Canvasback			
U.S. prairies	58 ns	47 ns	– 7 ns
Canada prairie/parkland	– 8 ns	– 37 **	– 26 ns
Boreal	– 19 ns	– 47 *	189 ns
Alaska	91 **	– 41 *	60 ns
Continental	4 ns	– 35 **	9 ns
Scaup sp.			
U.S. prairies	238 **	29 ns	10 ns
Canada prairie/parkland	16 ns	– 55 **	– 52 **
Boreal	11 *	– 31 **	– 15 ns
Alaska	11 ns	– 34 **	– 8 ns
Continental	14 **	– 34 **	– 19 **
Ring-necked Duck			
U.S. prairies	894 **	401 **	727 **
Canada prairie/parkland	351 **	– 67 **	41 ns
Boreal	323 **	– 17 ns	– 1 ns
Continental	341 **	– 9 ns	– 23 ns
Goldeneye sp.			
Canada prairie/parkland	102 **	10 ns	– 36 ns
Boreal	94 *	– 46 *	– 26 ns
Alaska	108 **	– 22 ns	– 30 ns
Continental	95 **	– 39 *	– 28 ns
Bufflehead			
Canada prairie/parkland	92 **	– 10 ns	12 ns
Boreal	120 **	12 ns	41 *
Alaska	62 **	3 ns	61 **
Continental	112 **	8 ns	39 **
Scoter sp.			
Canada prairie/parkland	41 ns	– 57 ns	– 70 ns
Boreal	4 ns	– 15 ns	– 5 ns
Alaska	18 *	– 22 ns	– 1 ns
Continental	7 ns	– 18 ns	– 5 ns
Merganser sp.			
Boreal	76 **	– 6 ns	– 4 ns
Continental	85 **	– 6 ns	– 6 ns
Total ducks			
U.S. prairies	9 ns	14 ns	– 2 ns
Canada prairie/parkland	– 36 **	– 41 **	– 37 **
Boreal	14 **	– 14 ns	33 *
Alaska	66 **	– 30 **	19 *
Continental	– 2 ns	– 21 **	0 ns
Ponds			
U.S. prairies	– 13 ns	– 10 ns	– 43 *
Canada prairie/parkland	– 22 *	– 2 ns	– 72 **
Continental	– 2 ns	– 22 **	1 ns

Note: Level of significance of the trend is indicated as follows: $0.05 \geq * > 0.01$; $0.01 > **$; ns = not significant.

The results of this study justify the special interest that Mallards, Blue-winged Teal, Northern Pintails, and Canvasbacks have received in recent years. These, and other species, will benefit from habitat securement and enhancement programs such as those funded under the North American Waterfowl Management Plan (Canadian Wildlife Service/U.S. Fish and Wildlife Service 1986).

Acknowledgements

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Appendix A

Figure A.1
Plot of population index over time for the Mallard

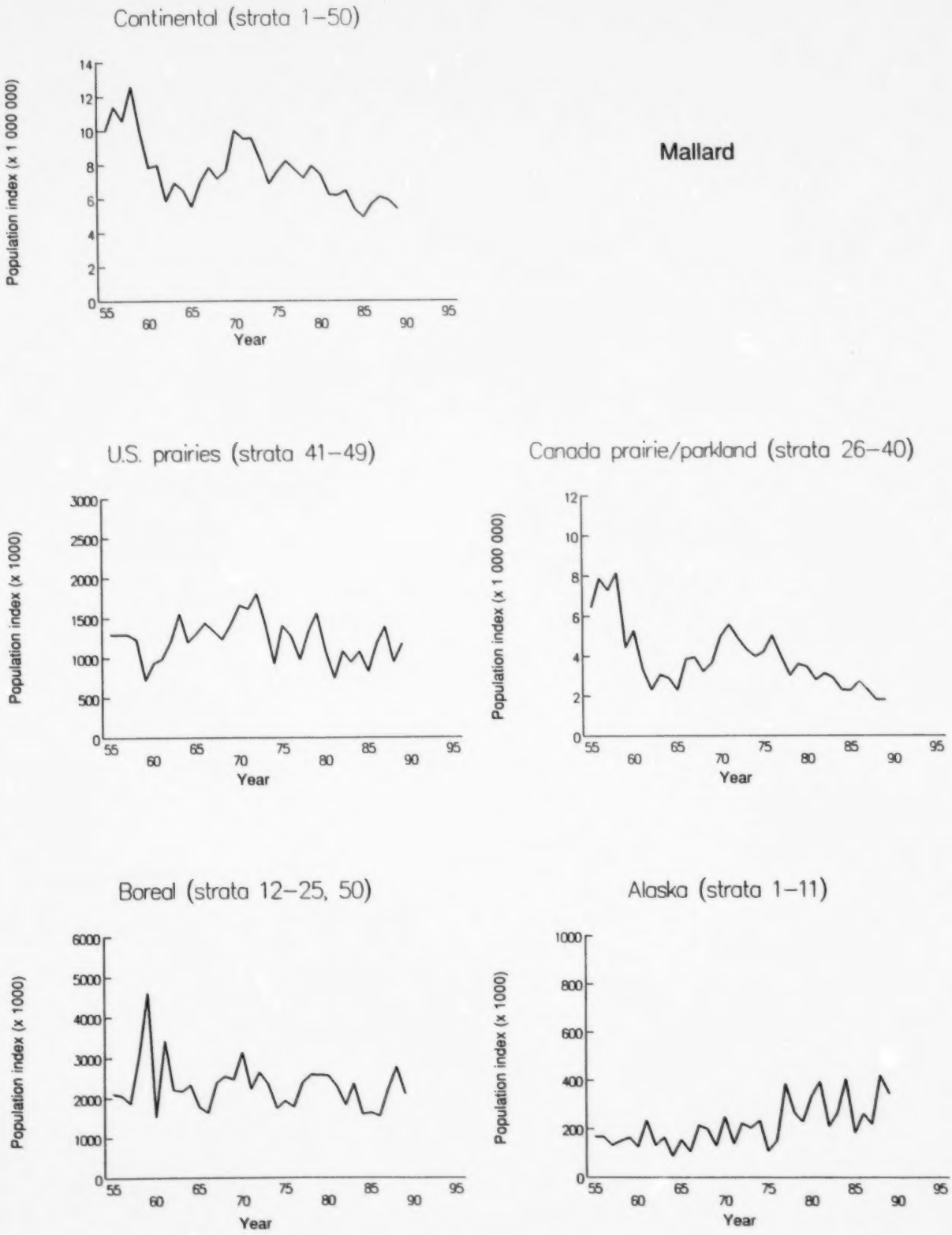

Figure A.2
Plot of population index over time for the Blue-winged Teal

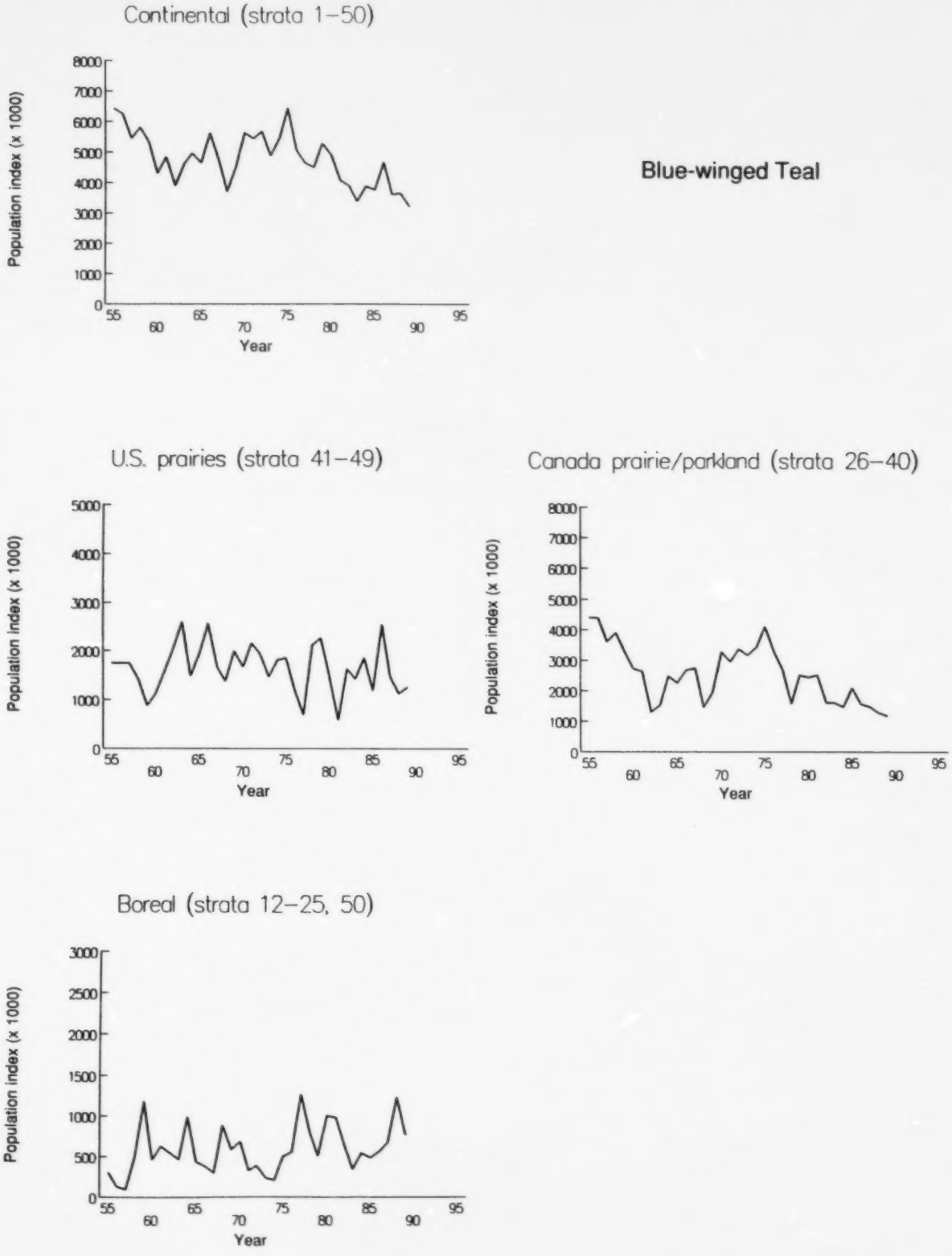

Figure A.3
Plot of population index over time for the Northern Pintail

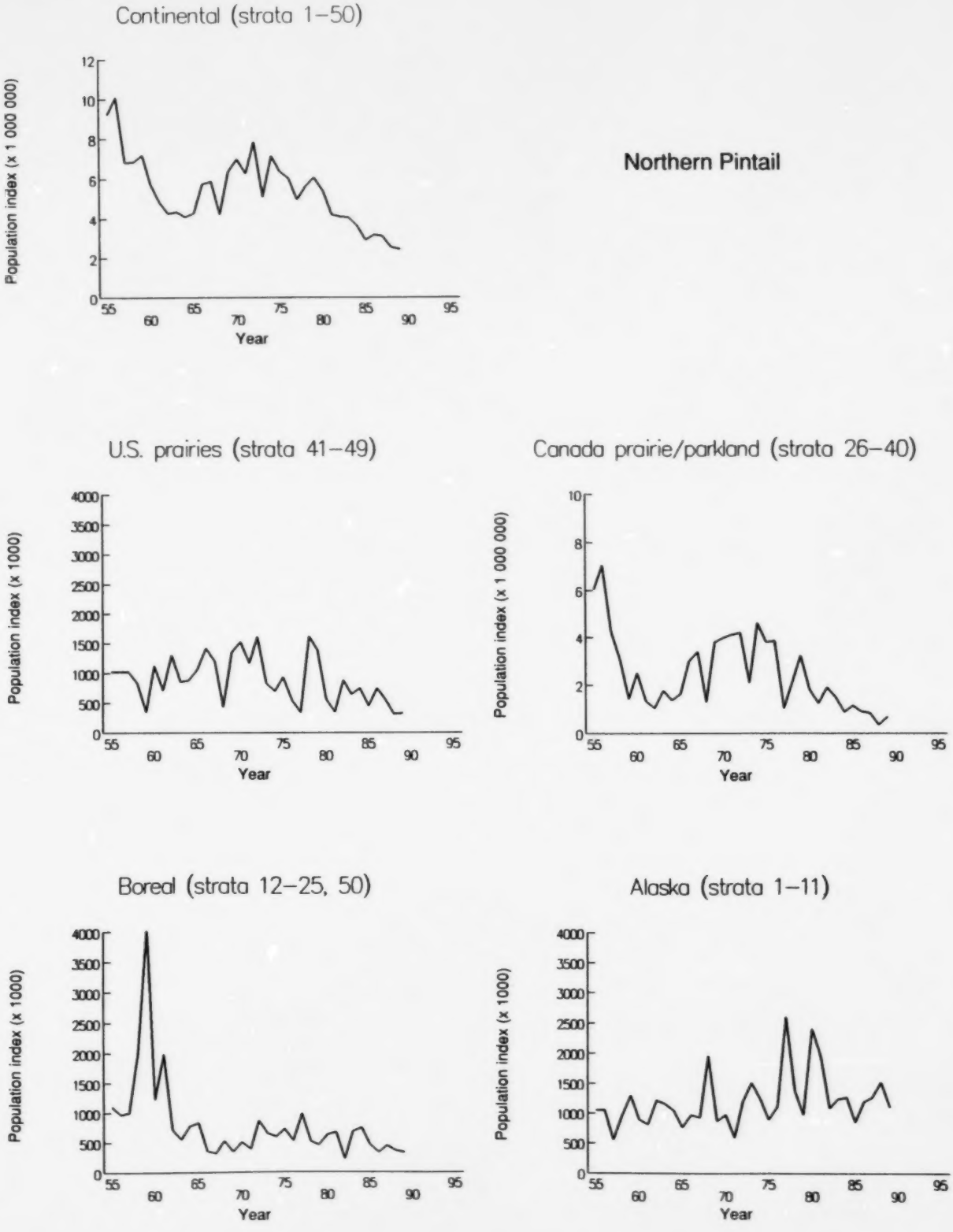

Figure A.4
Plot of population index over time for the Canvasback

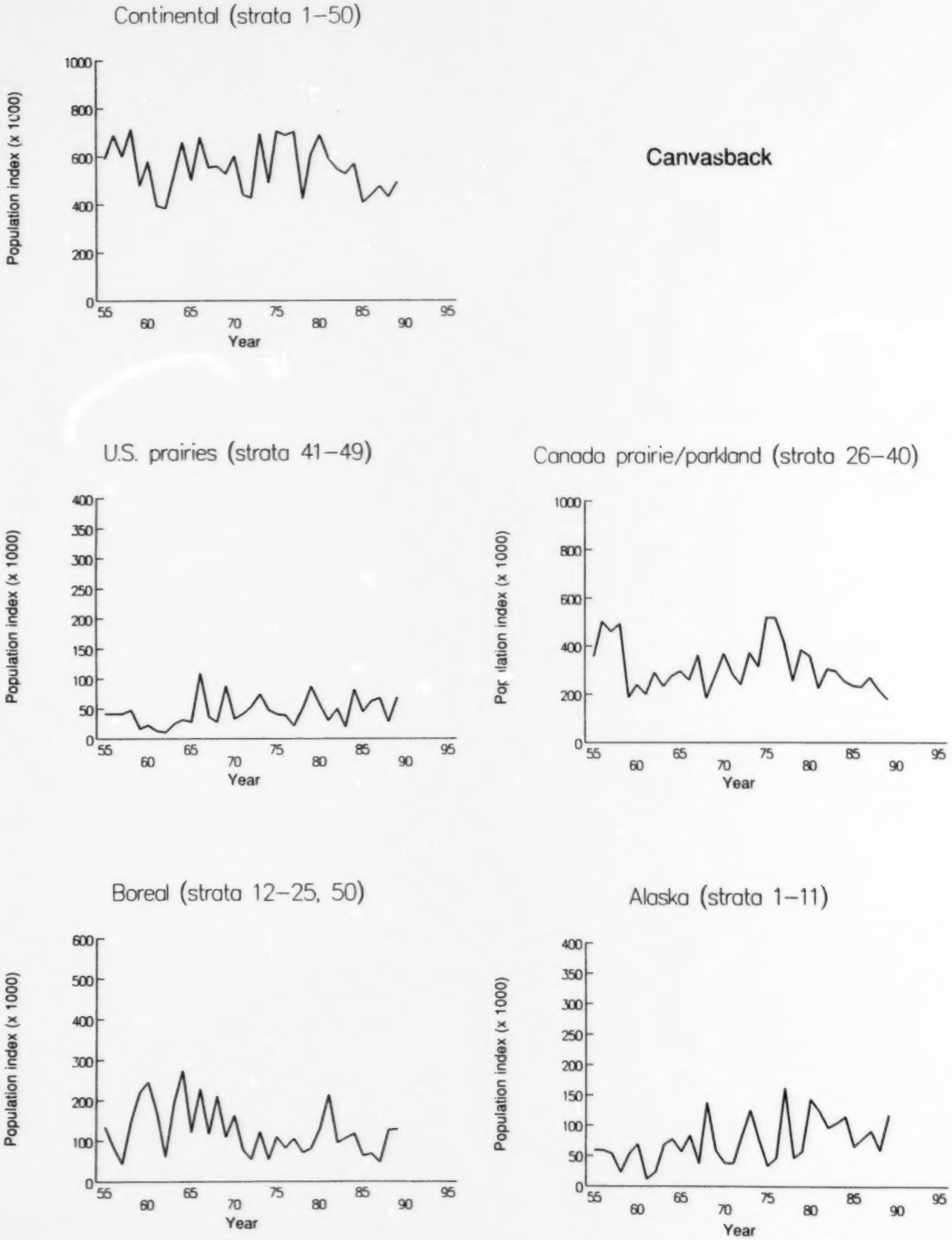

Figure A.5
Plot of population index over time for scaup sp.